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L. Larrabee Strow, Scott E. Hannon
Sergio DeSouza-Machado

University of Maryland Baltimore County, Baltimore, MD 21250 USA

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1 Channeling Spectra Sensitivity

AIRS suffers from a mild "channeling" phenomenon due to low finesse interference fringes created by reflections within the entrance filters. An example of the "channeling spectra" for one particular position of the AIRS channels and fringes is shown in figure 1. The channeling spectra shown is the difference in BT between including an estimate of the fringes in the model SRFs and ignoring them. Also shown for comparison purposes are the effects of a 1 um error in channel frequencies and a 2% error in width.

The channel frequencies and the position of the fringes depend on the grating and filter temperatures and the AMA position. So long as AIRS is stable, the fringes and channel center frequencies are also stable. Once the position (phase) of the fringes is known, they can be incorporated into our model of the AIRS SRFs, and from there included in our fast forward model.

A problem arises if AIRS is not stable. Recent in-orbit experience suggests that the while the channel frequencies are sensitive to the operating temperature, there is non-negligible hysteresis. If for some reason AIRS undergoes a temperature change (eg, a warm-up for de-icing, or an unexpected event), we may be able to return to the same channel frequencies by adjusting the temperature, but the final temperature might be different. And in this case, the fringes will have shifted.

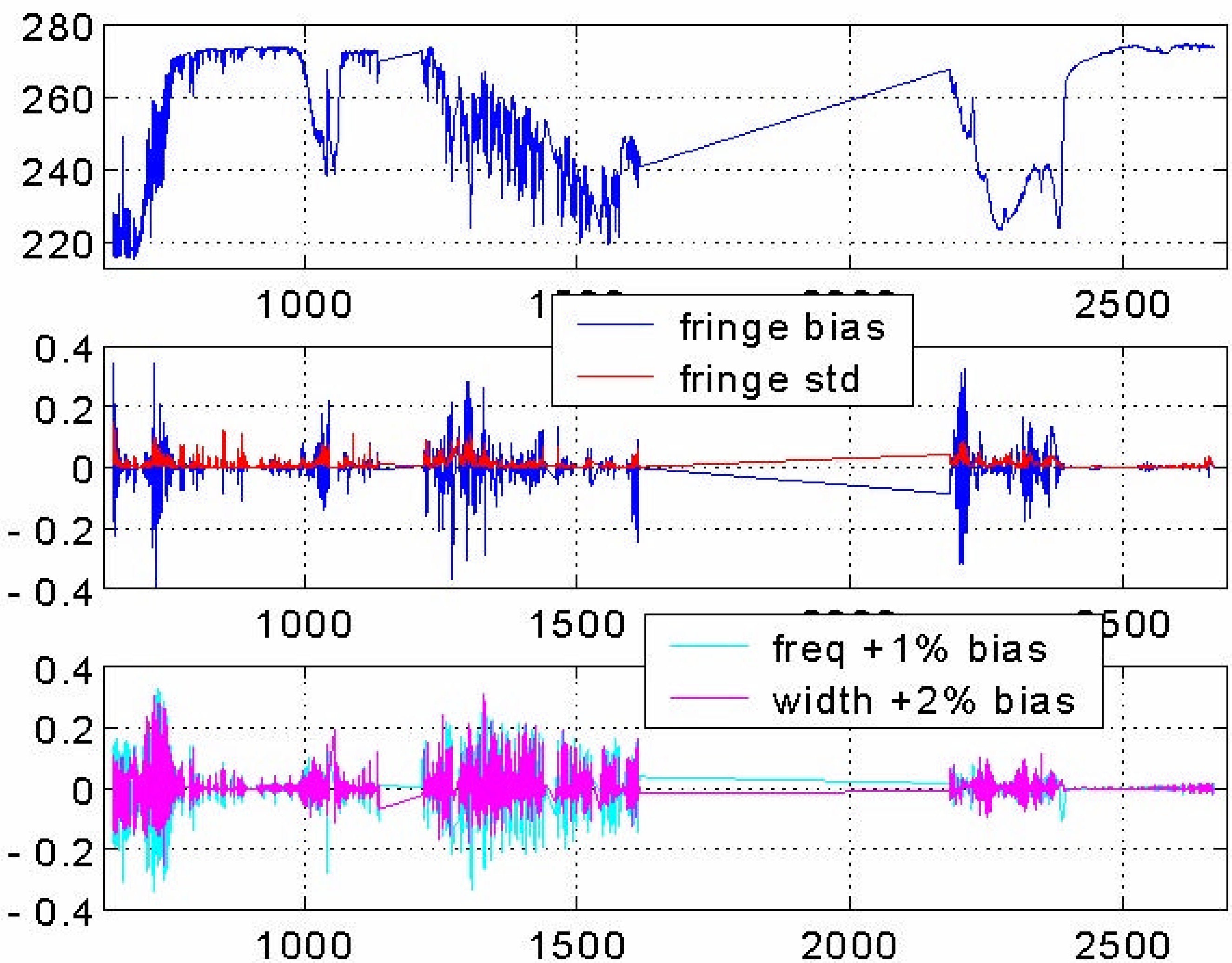

Figure 1: Simulated AIRS radiance showing the effect of the entrance filter fringes on the AIRS radiances. The results are biases over our 48 regression profiles at nadir. The top plot shows the mean BT spectrum. The middle plot is the "channeling spectra", that is the difference between including the fringes in the SRFs and ignoring them. The bottom plot shows the BT errors associated with errors of 1 % in the channel frequencies and 2% in the widths.

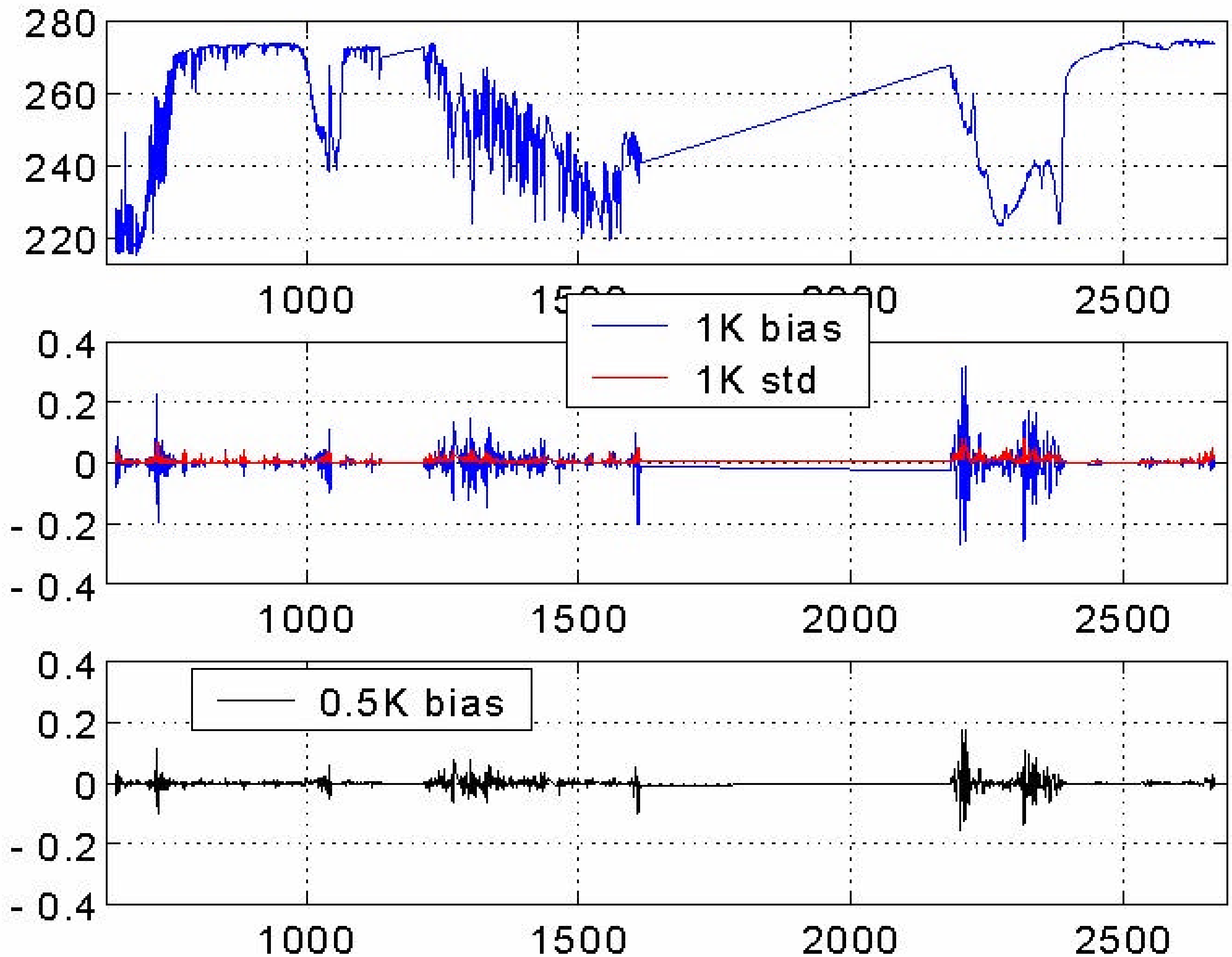

Figure 2: Simulated AIRS radiance showing the sensitivity of AIRS to shifts in position of the filter fringes. The results are biases over our 48 regression profiles at nadir. The top plot shows the mean BT spectrum. The middle plot shows the bias (mean) and standard deviation of the change in BT resulting from a +1 Kelvin change in filter temperature. The bottom plot shows the bias resulting from a +0.5 Kelvin change.

Figure 2 shows an example of the change in BT due to a +1 and +0.5 Kelvin change in filter temeprature. For this simulation, the fringes have moved but the channel frequencies have not. The 1 K change in filter temperature moved the fringes by approximately 10% of a channel width. This is a significant shift, especially for the shortwave channels, where the change in BT is of similar magnitude as the channeling spectra shown in figure 1.

2 The next AIRS fast model

We are scheduled to deliver the next AIRS fast model to JPL on 4 September 2002 (launch plus 4 months). To meet this deadline, we must start work on the new fast model by 16 August. By that time, the de-icing warmup should be over and AIRS re-calibrated. If not, it may be wise to bump the delivery as appropriate.

The main purpose of the new fast model is to use the true channel frequencies and complete-with-fringes SRFs. We are also considering including some spectroscopy improvements; Sergio is currently working on these. The two improvements currently under investigation are a revised water continuum in the main water band, and changes to the CO2 lineshape near 2280 and 2380 wavenumbers. There is also a problem with with non-LTE emission in the shortwave CO2 region that shows up in day-time AIRS observations, but a solution for this will take much longer to work out.

Figure 3 shows an example of the changes one can expect with the revised water contiunuum. The largest changes are in the 1600 wavenumber region, where there is strong bias to the changes. The statistics are for our 48 regression profiles at nadir, and as such they might slightly overstate the changes compared to more globally balanced profiles and all view angles. This new water continuum is something put together by Sergio; the rumored CKD 3.0 water continuum is not yet available.

Figure 4 shows an example of the changes to a night-time BT spectrum in the shortwave CO2 region. The change near 2380 cm-1 is in better shape than the change at 2280 cm-1 where we are having much more trouble. Sergio is still working on this and comparing it with observations. Most likely the changes will significantly reduce the obs-calc errors at 2380 but only slightly improve the obs-calc at 2280 cm-1.

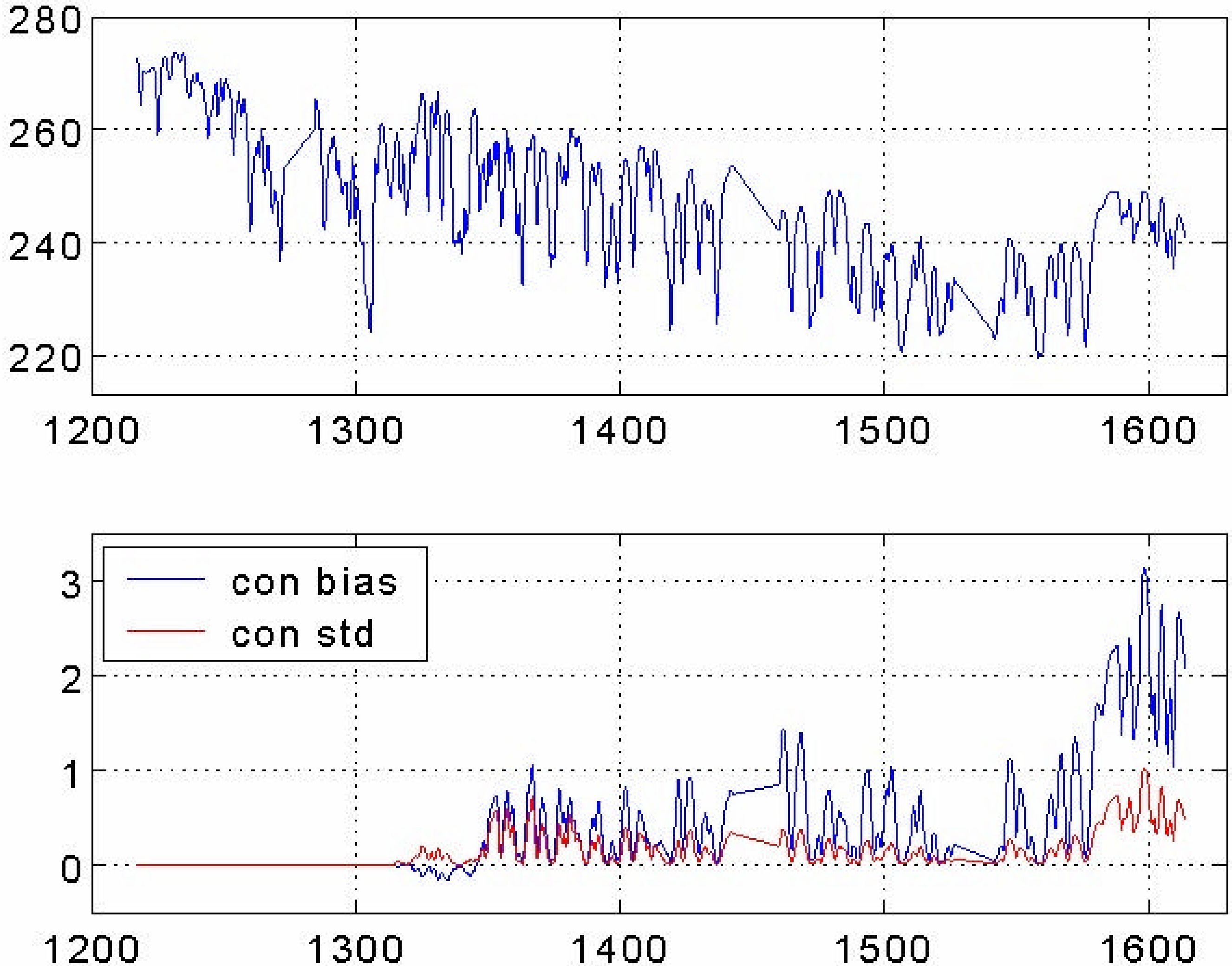

Figure 3: Simulated AIRS radiance showing the changes to the water continuum currently being evaluated for inclusion in the next (4 September 2002) AIRS fast model. The top plot shows the mean BT spectrum. The bottom plot shows the bias and standard deviation of the change in BT resulting from the revised water continuum. The statistics are for our 48 regression profiles at nadir.

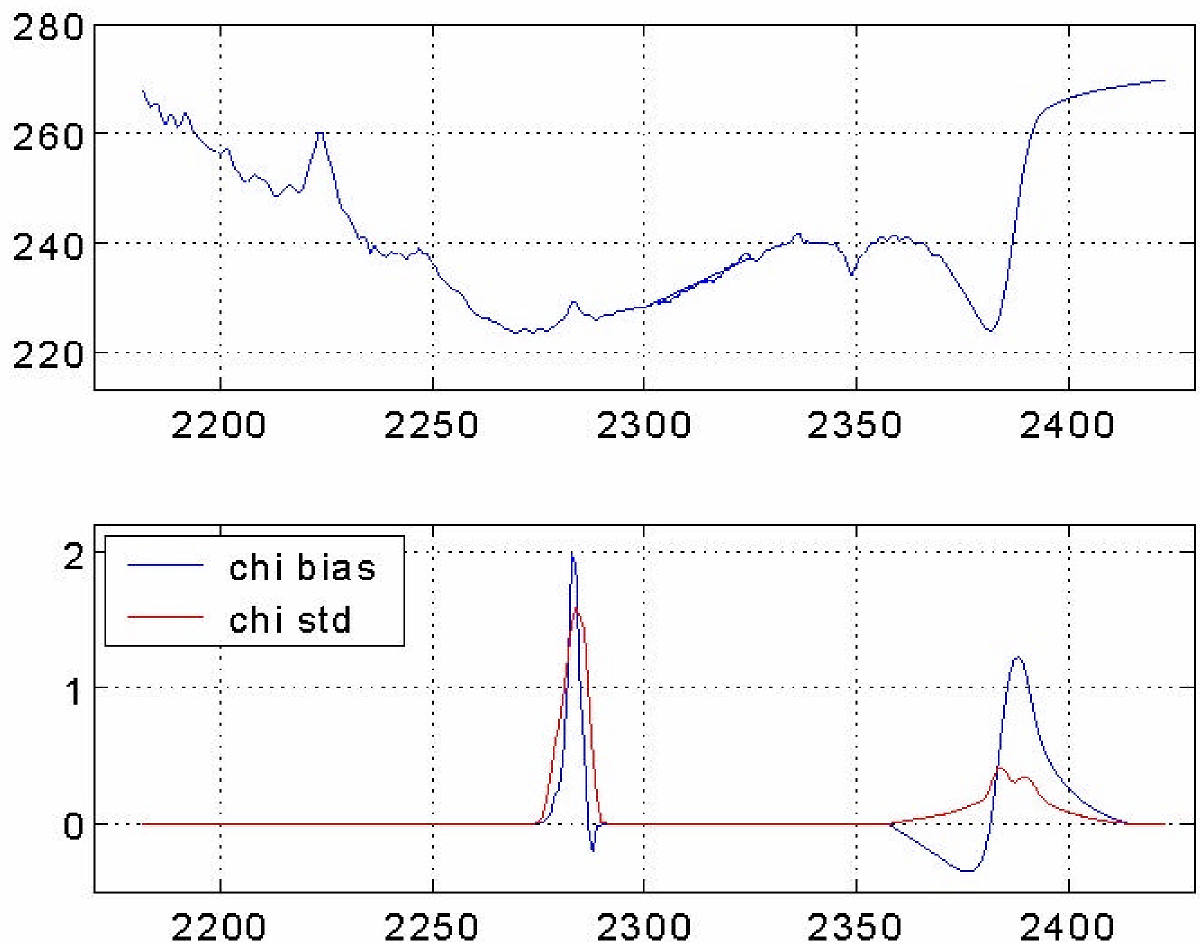

Figure 4: Simulated AIRS radiance showing the changes to the nighttime shortwave CO2 region currently being evaluated for inclusion in the next (4 September 2002) AIRS fast model. The top plot shows the mean BT spectrum. The bottom plot shows the bias and standard deviation of the change in BT resulting from the revised CO2 lineshape. The change at 2380 cm-1 looks like it will significantly reduce obs-calc errors, but the improvement at 2280 cm-1 will likely be much less. The statistics are for our 48 regression profiles at nadir.